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BIOLOGICAL EVALUATION OF PINE RESIN MIDGE AND ELYTRODERMA DISEASE ON THREE SALES, McCLOUD RANGER DISTRICT, SHASTA-TRINITY NATIONAL FOREST

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ABSTRACT

Three timber sales contained ponderosa pines with heavy infestations of pine resin midge and light to moderate infections of Elytroderma disease. Many of the pines infested with the midge were sawtimber trees, an unusual situation for this insect. Management alternatives include no action, changing the marking guidelines, and clear cutting.

INTRODUCTION

On May 27, 1987, we accompanied Bill McBain to three areas on the McCloud Ranger District: The Tail, Bull, and Summit Timber Sales (Fig. 1; T, B and S, respectively). The Bull and Summit Sales have been sold; the Tail Sale remains unsold. The Tail and Summit Sales are clear cuts, while the Bull Sale consists of a mix of partial and clear cuts. The District was concerned that thinning crowns and scattered mortality were indicative of causal agents that should be considered in maintaining or changing the marking in the sales.

OBSERVATIONS

Ponderosa pine was the primary tree species at each site, but white fir, incense-cedar, Douglas-fir and some lodgepole pine were also present in these mixed-conifer stands. Many of the pines were obviously healthy. Others, ranging from saplings to sawlog-size trees, were infested by the pine resin midge (Cecidomyia piniinopis) and/or infected by Elytroderma disease (Elytroderma deformans). There was evidence in branch scars and deformations

that attacks by the pine resin midge on saplings had occurred over a 12-year period at the Bull Sale. The Tail Sale was not as seriously affected and the Summit Sale trees were the least damaged. Although Elytroderma disease was observed in the ponderosa pines, infections involved less than half of the live crown and are not having a significant impact on tree growth.

The three areas were natural stands, not the plantations of sapling pines where pine resin midge is commonly seen. Most unusual was the size of some pines under heavy attack by the midge. Many trees were greater than 20 inches dbh and over 100 ft. in height. Yet, only the uppermost whorls, often only 10 to 20% of the crown, had escaped heavy attack (Fig. 2). Frequently, adjacent to these trees were pines of the same size that had few obvious attacks. This difference may be related to the "viscid or nonviscid" shoots of trees, where pines with viscid shoots have more damage from pine resin midge than pines with nonviscid shoots. Examination of two pairs of such trees showed radial growth of heavily infested pines over the past 10 years to be half that of the growth between 10 and 20 years ago. Meanwhile, the uninfested trees had maintained the same growth rate over the twenty-year period.

Current pest activity in the Tail and Summit Sales appeared limited to pine resin midge and elytroderma disease. However, a small amount of black stain root disease (Ceratocystis wageneri) was found in one moist area in the vicinity of the Bull Sale, where western pine beetle (Dendroctonus brevicomis) and red turpentine beetle (D. valens) also were present. Mountain pine beetle (D. ponderosae), red turpentine beetle, and the California flatheaded borer (Melanophila californica) had attacked scattered, individual pines within the sale.

While examining these sales, a separate situation was observed in the Harris Springs area. A large amount of slash had been created by late winter logging. The intact tops had become heavily infested by pine engravers, Ips spp. Development on May 27 indicated the potential for 2 and one-half generations by the end of the summer.

DISCUSSION

This is the first instance where the authors have seen such a heavy infestation of pine resin midge in natural stands. The larger pines with heavy attacks are obviously having their growth reduced because a large proportion of the crown is involved. Why the population expanded to produce such damage is not known, but the insect has been damaging saplings in these areas for about a decade. The recent slow growth of the heavily infested large pines indicates that they also may have been damaged for several years. A relationship between the presence of both pine resin midge and Elytroderma disease was not apparent.

These sales are scheduled for the autumn. This will avoid the creation of slash at a time of year that provides favorable host material for pine engravers. Should the harvest be delayed until the winter or spring, slash between 3 and 10 inches in diameter should be treated in such a way that it dries out rapidly.

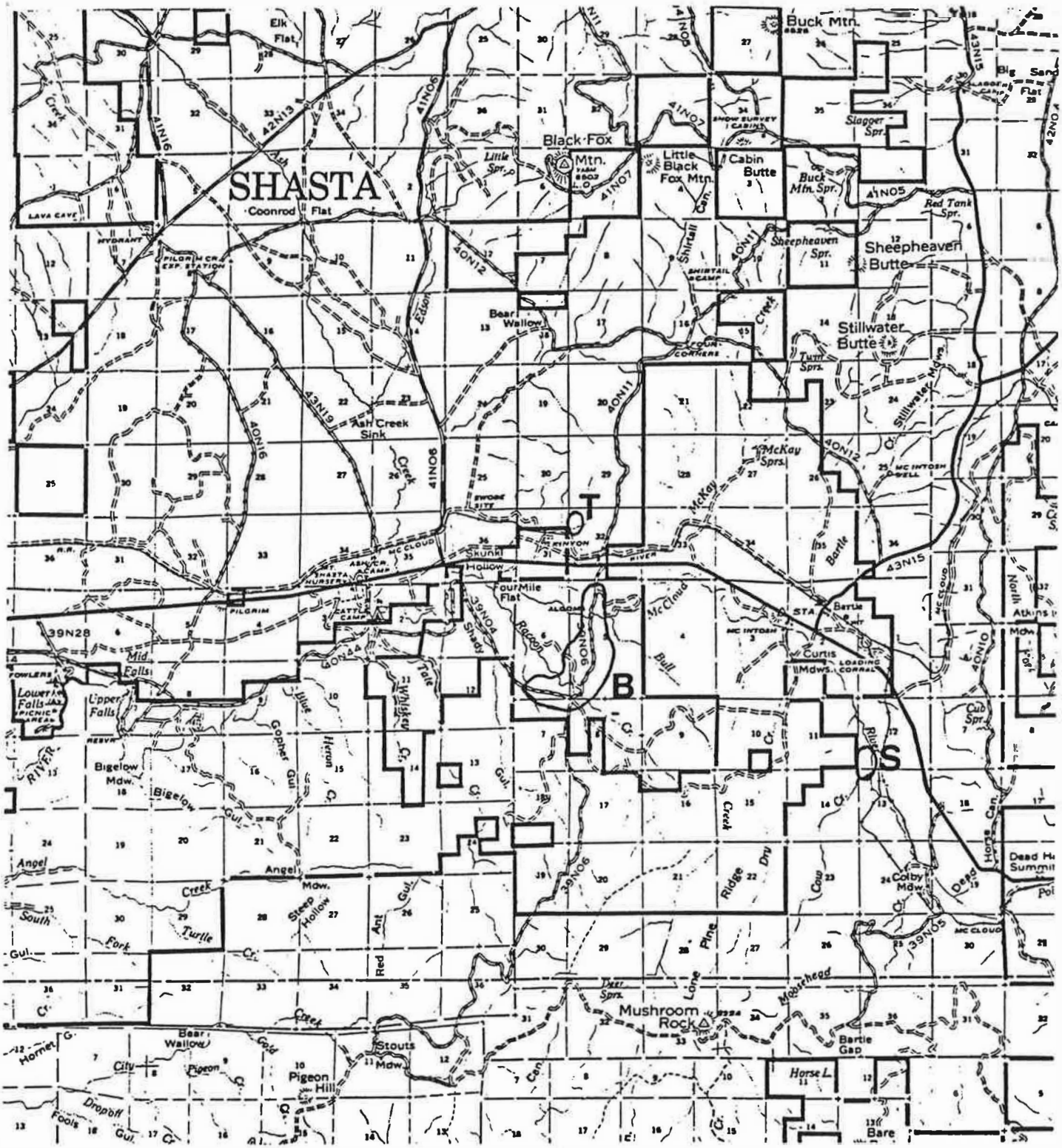

Figure 1. Location of three timber sales impacted by pine resin midge and Elytroderma disease, McCloud District, Shasta-Trinity National Forest. Sales: Tail (T), Bull (B), Summit (S).

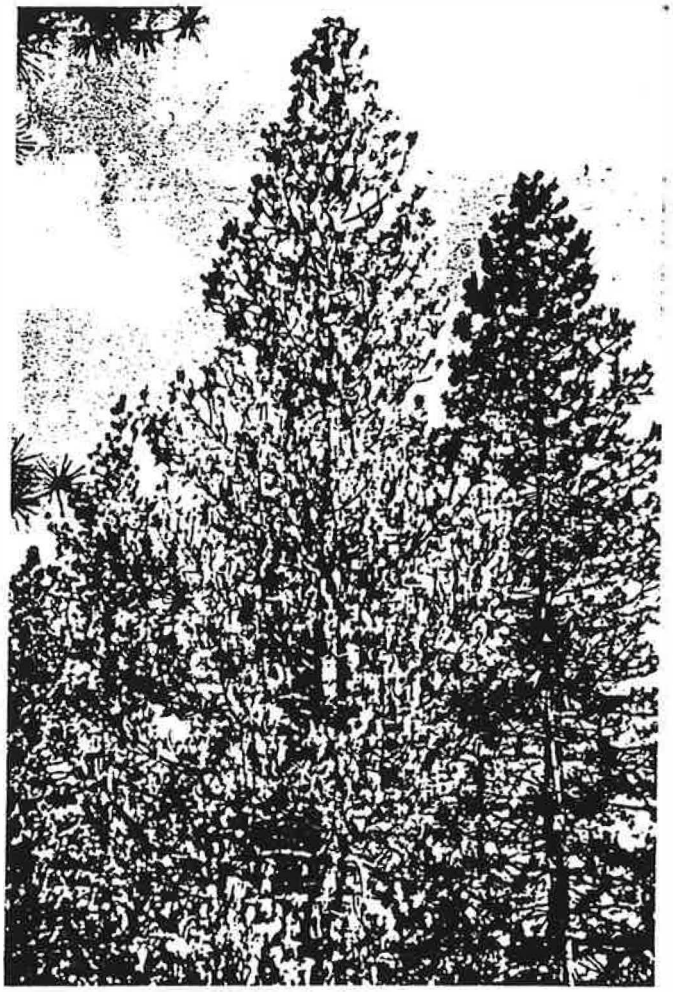

Figure 2. Large ponderosa pine with heavy pine resin midge damage (left), and pine with little damage (right), Bull Sale, McCloud District, Shasta-Trinity National Forest.

MANAGEMENT ALTERNATIVES

No Action. This alternative would leave the stands as presently marked. In the Bull Sale, many of the heavily infested trees would remain following partial cutting. These slow-growing trees would require two years to recover a substantial portion of their photosynthetic potential once the infestation has declined. Normally, decline would be anticipated within two to four years of outbreak. However, the growth patterns on large trees and the scars on saplings indicate that the infestation may have surpassed this period. Once collapse has occurred, a recurrence on the larger pines is feasible, though not predictable in time interval. Therefore, it seems that no action would leave a substantial number of very susceptible pines in the partial cuts. Susceptibility to heavy damage by the midge indicates that growth projections for these trees could be less than expected. The impact of the midge and Elytroderma also makes the pines more susceptible to attack by the several species of bark beetles in the area.

Change the Marking. This could require changing the trees marked or increasing the number of marked trees. Those exhibiting heavy damage from the midge or Elytroderma disease would be objects of the change or increase in the number of marks. The objective would be to leave as growing stock and parent trees those pines which apparently are less susceptible. Cones should not be collected from heavily infested trees. This would perpetuate the genetic characteristics related to susceptibility[1/]. Thinning of the denser clusters of trees would reduce the impact of damage and the shortfall in growth.

Clear Cutting. Changing the partial cut units to clear cuts, and delineating the clear cuts to include all of the infestations, would eliminate the present midge problem, but might not meet other management objectives. At the present time, there also is no assurance that planting stock will not be as susceptible as the present stocking. No guidelines presently exist that would discriminate against collecting seed from pines with the viscid characteristic.

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1. Austin, L., J.S. Yuill, and Kathleen G. Brecheen. 1945. Use of shoot characters in selecting ponderosa pine resistant to resin midge. Ecology 26: 288-296.

PEST BIOLOGIES

PINE RESIN MIDGE

Adults of the pine resin Midge, Cecidomyia piniinopis, are small mosquito-like flies. Pitch midge adults emerge from late March through early May and lay eggs on expanding branch and leader tips of the primary host, ponderosa pine. The larvae that hatch from the eggs bore through the surface of the shoot and embed themselves in the vascular tissue. The larvae feed in resin-filled cavities until late winter or early spring when they crawl out of the feeding pits to pupate on the needles.

A few feeding pits on a shoot will have little effect on the tree, but as the number increases, growth and conduction will be affected. If the pits girdle the shoot, it will die. When the pits are distributed on only one side of the twig, the difference in growth rate causes a twisted branch or leader. The feeding pits cause a canker-like scar which remains visible on the twig for many years. Repeated infestations will reduce the growth rate, cause deformity and predispose the tree to attack by other organisms.

Trees under three years of age are sledom attaked. Foliage more than 16 feet high is only occasionally infested, but the present situation on the McCloud District is one of those occasions. Host tree vigor has little to do with susceptibility to the pine resin midge, but it will affect the impact of the infestation. The same level of infestation is more likely to produce twig and leader death in slowly growing trees than in rapidly growing ones.

The susceptibility of ponderosa pine to the midge is related to the type of surface of the spring shoots. During the period of active new grwoth, trees will exhibit one of three genetically controlled phenotypes. The shoots will either be resinous, dry and smooth, or covered with a waxy bloom. Trees with resinous (viscid) shoots normally comprise about one-third of the population and are much more prone to serious pitch midge damage, although the midge is capable of developing in all three types.

Midge damage can be minimized in regeneration programs by avoiding ponderosa pine with resinous spring shoots for cone collections, seed trees or tree breeding projects. Damage will not be totally eliminated even if most of the regeneration display the less susceptible (dry and smooth or waxy) phenotypes because vegetative competition and population levels of the midge also influence the level of damage. When midge populations are very high, some trees displaying the unsusceptible phenotype will be attacked and conversely, when midge levels are low, some susceptible trees will escape attack.

ELYTRODERMA DISEASE

The fungus Elytroderma deformans causes the most serious needle disease of ponderosa and Jeffrey pines in California. Occasional hosts include lodgepole, knobcone, Coulter, and pinyon pines. Unlike other needle diseases, Elytroderma infects twigs and branches systemically, allowing continued reinfection of a host's new needles even under adverse environmental conditions. Elytroderma impact is most severe in recreation forests, where the unsightly appearance of infected trees and occasional mortality can degrade the appearance and health of a stand.

Fungal fruiting bodies (hysterothecia) release spores from infected needles in late summer and early fall. Spores are windborne to susceptible hosts and, if environmental conditions are suitable, they germinate and infect the current year's needles. Initially, the fungus grows through the needle and into the twig without killing the needle. The following spring, infected needles die and turn a conspicuous red-brown. Infected branches take on a characteristic appearance, with current year's needles looking green and healthy while the one-year-old, infected needles are bright red-brown. Long, narrow, dull black fruiting bodies form on all surfaces of the dead needles and mature later in the summer, completing the infection cycle.

Fungal mycelium within the twigs spreads into the growing tips and buds, deforming future branch growth. As a result, infected branches have a broomed appearance similar to that caused by dwarf mistletoes. However, Elytroderma brooms are distinguished by several characteristics: the red-brown color of one-year-old needles in spring and early summer; fruiting bodies scattered over the needle surface; resinous, brown necrotic lesions in the inner bark of twigs and branches infected for three years or more; and, a lack of mistletoe shoots or basal cups.

Elytroderma disease kills one-year-old needles prematurely and deforms infected twigs and branches. Generally, pines are little affected if fewer than 40 percent of the twigs are infected. The disease seldom kills mature trees directly, but moderate-to-severe infection can predispose them to bark beetle attack. The disease is most severe on seedlings, saplings, and poles that are suppressed or have thin crowns. Disease outbreaks are uncommon, but once started, the disease can persist for many years, particularly in moist sites.